MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

DMT5131 – MATHEMATICAL TECHNIQUES 1

(For DIT students only)

29 MAY 2019
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **2** pages with **3** questions excluding the cover page and Appendix. Key formulae are given in the Appendix.
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.
4. All necessary working steps must be shown.

Question 1

a. Find the solution of $|3x-4| = 2x+4$. (2 marks)

b. Solve the inequality, $\frac{(x+3)(x-5)}{2x-1} \geq 0$. (3 marks)

c. Given a quadratic function, $f(x) = -3x^2 - 3x + 6$.

i. Determine whether the parabola opens upward or downward. (0.5 mark)

ii. Find the discriminant of $f(x)$. Then, identify the type of solution(s). (1 mark)

iii. Find the x-intercept and y-intercept of $f(x)$. (2 marks)

iv. State the vertex of $f(x)$. (1 mark)

v. Determine whether the vertex is a maximum or minimum point. (0.5 mark)

[TOTAL 10 MARKS]

Question 2

a. Compute $B - A$ if given that $A = \begin{bmatrix} -32 & -19 \\ 13 & 10 \\ 22 & -25 \end{bmatrix}$ and $B = \begin{bmatrix} -11 & -35 \\ 42 & 52 \\ 69 & -34 \end{bmatrix}$. (1.5 marks)

b. A factory produces two types of clock – digital and analogue. The following table shows the cost of the components used in producing each clock.

	Labour (hours)	Materials (boxes)	Electricity (units)
Digital	7	5	0.5
Analogue	4	3	0.3

i. Represent the information given in the table as a 2×3 matrix P. (0.5 mark)

ii. If given the labour cost RM6 per hour, the material used costs RM1 per box and electricity costs RM0.22 per unit, put these information as a column matrix Q. (0.5 mark)

iii. Compute PQ. (1.5 marks)

c. Given below a system of linear equations. Solve for x, y and z using Cramer's rule.

$$2x + 2y - z = 2$$
$$x - 3y + z = -28$$
$$-x + y = 14$$

(11 marks)

[TOTAL 15 MARKS]

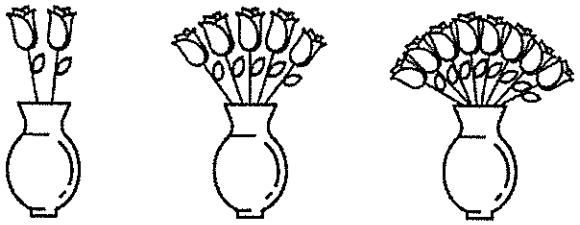
Continued.....

Question 3

a. Find the sum of the sequence $\sum_{k=3}^{6} \frac{k^2 - k}{k!}$. Leave the answer in fraction form.

(3 marks)

b. Figure below shows the first 3 sets of flower arrangement using roses.



Determine the number of sets that can be made using 126 roses. (4 marks)

c. Find the sum of the infinite geometric series, $5 - \frac{5}{3} + \frac{5}{9} - \frac{5}{27} + \ldots$ (3 marks)

d. Find the first four terms of the expansion $(x^3 + 3y)^8$. (5 marks)

[TOTAL 15 MARKS]

End of Page

Appendix

Inequalities:

$\|u\| < a \quad \Rightarrow \quad -a < u < a$	$\|u\| > a \quad \Rightarrow \quad u < -a \quad or \quad u > a$
$\|u\| \leq a \quad \Rightarrow \quad -a \leq u \leq a$	$\|u\| \geq a \quad \Rightarrow \quad u \leq -a \quad or \quad u \geq a$

Completing the square:

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2$$

Quadratic formula:

If $ax^2 + bx + c = 0$ where $a \neq 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Standard form of a quadratic function:

$f(x) = a(x-h)^2 + k,\ a \neq 0$

Determinant of a 2 × 2 matrix	***Determinant of a 3 × 3 matrix***
$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$
Inverse of a 2 × 2 matrix	***Inverse of a 3 × 3 matrix***
If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ then $A^{-1} = \dfrac{1}{ad - bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ where $ad - bc \neq 0$.	$A^{-1} = \dfrac{1}{\|A\|}\left[c_{ij}\right]^T$ $A^{-1} = \dfrac{1}{\|A\|}\begin{bmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{bmatrix}$ $A^{-1} = \dfrac{1}{\|A\|} adj\ A$ where $\left[c_{ij}\right]^T$ is called the adjoint of A (adj A). c_{ij} of the entry $a_{ij} = (-1)^{i+j} M_{ij}$

Cramer's Rule for 2 × 2 matrix	*Cramer's Rule for 3 × 3 matrix*
If $\begin{aligned} a_1x+b_1y&=c_1\\ a_2x+b_2y&=c_2 \end{aligned}$ then $x=\dfrac{\begin{vmatrix} c_1 & b_1\\ c_2 & b_2\end{vmatrix}}{\begin{vmatrix} a_1 & b_1\\ a_2 & b_2\end{vmatrix}}$ and $y=\dfrac{\begin{vmatrix} a_1 & c_1\\ a_2 & c_2\end{vmatrix}}{\begin{vmatrix} a_1 & b_1\\ a_2 & b_2\end{vmatrix}}$ where $\begin{vmatrix} a_1 & b_1\\ a_2 & b_2\end{vmatrix}\neq 0$	If $\begin{aligned} a_1x+b_1y+c_1z&=d_1\\ a_2x+b_2y+c_2z&=d_2\\ a_3x+b_3y+c_3z&=d_3 \end{aligned}$ then $x=\dfrac{D_x}{D}, y=\dfrac{D_y}{D}, z=\dfrac{D_z}{D}$ where $D=\begin{vmatrix} a_1 & b_1 & c_1\\ a_2 & b_2 & c_2\\ a_3 & b_3 & c_3\end{vmatrix}, D_x=\begin{vmatrix} d_1 & b_1 & c_1\\ d_2 & b_2 & c_2\\ d_3 & b_3 & c_3\end{vmatrix},$ $D_y=\begin{vmatrix} a_1 & d_1 & c_1\\ a_2 & d_2 & c_2\\ a_3 & d_3 & c_3\end{vmatrix}, D_z=\begin{vmatrix} a_1 & b_1 & d_1\\ a_2 & b_2 & d_2\\ a_3 & b_3 & d_3\end{vmatrix}$

Arithmetic sequence	*Geometric sequence*
$a_n=a_1+(n-1)d$ $S_n=\dfrac{n}{2}(a_1+a_n)$	$a_n=a_1r^{n-1}, S_n=\dfrac{a_1(1-r^n)}{1-r}$ $S_\infty=\dfrac{a_1}{1-r}, \lvert r\rvert<1$

Binomial Theorem

$$(a+b)^n=\sum_{k=0}^{n}\binom{n}{k}a^{n-k}b^k;\quad n\geq 1$$

The $(r+1)^{st}$ term in the expansion of $(a+b)^n$ is $\binom{n}{r}a^{n-r}b^r$.